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UNITED STATES PATENT APPLICATION

FOR

METERING VALVE

METERING VALVE

CROSS- REFERENCE TO RELATED APPLICATIONS

The present invention is a continuation in part of U.S. Patent Application
5 Serial No. 10/151,737 for Metering Valve filed on May 20, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a valve for metering dry bulk powdered materials, such as for example cement. The primary purpose of this valve is to proportionally meter bulk material for a blending or mixing operation. This design has an approximately linear characteristic wherein equal displacements of the valve sleeve will obtain approximately equal increases in valve opening area. This arrangement makes it well suited to automatic control of bulk materials.

Specifically, the present invention is an improved metering valve that addresses a variety of problems related to current metering valves, i.e. the problems of dry powdered material accumulating between the valve sleeve and the valve housing thus making the valve hard to turn, excessive wear on the valve caused by the abrasive action of the dry powdered material, incomplete sealing the valve when the valve is closed, and dry powdered material plugging off the vacuum breakers provided on the valve. In addition "dirty" cement may contain small rocks and other foreign material that may interfere with the normal operation of the valve. The foreign material may lodge in between the valve

sleeve and body thus causing the valve not to turn or causing damage to the valve mating surfaces.

2. Description of the Related Art

Current metering valves employed to meter dry bulk powdered material, such as cement, present a variety of problems. First, current metering valves have a problem with dry powdered material accumulating between the valve

- 5 sleeve and the valve housing. Because both the valve sleeve and the valve housing are circular in shape and the clearance between the valve sleeve and valve housing on current metering valves is uniform around the entire circumference of the valve sleeve, the dry powdered material tends to pack into the gap separating the valve sleeve and housing and forms a hardened layer
- 10 between the two valve members. This hardened layer causes wear of the valve and can ultimately cause the valve sleeve to bind or freeze up within the housing. The valve must then be taken out of service and disassembled so that the hardened layer can be chipped off of the valve. Removing the valve from service for this type of maintenance is time consuming, labor intensive, and costly.

- 15 A second problem with current metering valves is that the leading edge of the sleeve opening provided in the valve sleeve is the point at which the greatest wear due to abrasion by the dry powdered material occurs. Excessive wear on the valve caused by the abrasive action of the dry powdered material allows more of the dry powdered material to enter the gap between the valve sleeve and
- 20 the housing, thus acerbating the previously described problem of dry powdered material forming a hardened layer in the gap.

Also, with the leading edge of the sleeve opening worn by the abrasive action of the dry powdered material, the valve does not seal tightly when the valve is closed.

A final problem with current metering valves is that dry powdered material

5 sometimes enters the mouths of the vacuum breakers provided in the valves and plugs off the openings to the vacuum breakers. If dry powder becomes plugged within the vacuum breakers, this may allow bulk material to be discharged externally, thus causing an environmental problem for the operator. He may not be able to see due to dust, and the dust is unhealthy to breathe. Current

10 metering valves have the mouths of the vacuum breakers open to the housing of the valves, thus allowing dry powdered material to fly into the mouths and come into contact with the moisture. The moistened powdered material will then set up and over time will completely plug the openings to the vacuum breakers, making the vacuum breakers inoperative.

15 The present invention addresses these problems by providing a metering valve with greater clearance between the valve sleeve and housing in the areas not adjacent to the metering edges of the housing. With greater clearance between the valve sleeve and housing except at the sealing surface or lip, the problem of creating an unwanted hardened layer or interference with foreign

20 particles in the gap separating these valve elements is either eliminated or greatly improved.

The present invention also is provided with an eccentric intermediate sleeve that serves to align the valve sleeve relative to the housing. By rotating the intermediate sleeve slightly, this rotational motion of the intermediate sleeve translates into a back-and-forth motion of the valve sleeve, thus moving the valve 5 sleeve either nearer or further from the front side of the valve body, i.e. the side of the valve body through which the dry powdered material enters the valve.

The ability to move the valve sleeve toward or away from the front side of the valve body independent of the rotational movement of the valve sleeve allows the valve sleeve to move away from the housing before it is rotated and then 10 moved back toward the front side of the valve body once the valve sleeve has been rotated, thus forming a tight seal between the sleeve and sealing surface or lip located adjacent the inlet opening provided in the front side of the valve body for admitting dry powder material to the valve. A rubberized layer is added to the exterior surface of the valve sleeve to further enhance the seal between the valve 15 sleeve and the housing. By moving the valve sleeve away from the housing employing the eccentric intermediate sleeve, the layer is disengaged from contact with the housing prior to the valve sleeve being rotated. Otherwise, the layer would be damaged when the valve was opened and closed.

In order to prevent dry powder material from blowing into the mouths of 20 the vacuum breakers, a sleeve shield is provided in the present valve to cover the openings leading to the vacuum breakers. The sleeve shield is sealed to the

housing of the valve upstream of the openings that lead to the vacuum breakers, and the sleeve shield extends downstream of the openings.

Finally, the present invention employs ball bearings to suspend the valve sleeve within the housing, thereby making the valve sleeve easier to rotate.

SUMMARY OF THE INVENTION

The present invention is a metering valve with greater clearance between the valve sleeve and the areas of the housing not adjacent to the metering edges of the housing. This is achieved by employing a housing that, when viewed in cross section, has an interior surface that is not perfectly circular, but is instead expanded outward slightly just adjacent to the inlet opening of the housing. This creates greater clearance between the valve sleeve and the housing except at the sealing surface or lip of the valve. With this greater clearance within the valve, the problem of creating an unwanted hardened layer in the gap separating these valve elements, i.e. the housing and the metering sleeve, is either eliminated or greatly improved.

The present invention also is provided with an eccentric intermediate sleeve that serves to align the valve sleeve relative to the housing. By rotating the intermediate sleeve slightly, this rotational motion of the intermediate sleeve translates into a back-and-forth motion of the valve sleeve, thus moving the valve sleeve either nearer or further from the front side of the valve body, i.e. the side of the valve body through which the dry powdered material enters the valve.

The ability to move the valve sleeve toward or away from the front side of the valve body independent of the rotational movement of the valve sleeve allows the valve sleeve to move away from the housing before it is rotated and then moved back toward the front side of the valve body once the valve sleeve has been rotated, thus forming a tight seal between the sleeve and the inlet opening

provided in the front side of the valve body for admitting dry powder material to the valve. A rubberized layer is added to the exterior surface of the valve sleeve to further enhance the seal between the valve sleeve and the housing. By moving the valve sleeve away from the housing employing the eccentric intermediate sleeve, the layer is disengaged from contact with the housing prior to the valve sleeve being rotated. Otherwise, the layer would be damaged when the valve was opened and closed.

In order to prevent dry powder material from blowing into the mouths of the vacuum breakers, a sleeve shield is provided in the present valve to cover the openings leading to the vacuum breakers. The sleeve shield is sealed to the housing of the valve upstream of the openings that lead to the vacuum breakers, and the sleeve shield extends downstream of the openings.

Finally, the present invention employs ball bearings to suspend the valve sleeve within the housing, thereby making the valve sleeve easier to rotate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side view of the exterior of a metering valve for use with dry powdered material constructed in accordance with a preferred embodiment of
5 the present invention.

FIGURE 2 is a top plan of the metering valve of figure 1.

FIGURE 3 is a cross sectional view taken along line 3-3 of figure 2.

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FIGURE 4 is a cross sectional view of the housing and sleeve taken from the valve of figure 3.

FIGURE 5 is a cross sectional view of the housing taken along line 5-5
15 from figure 4 with the valve sleeve shown in a closed position relative to the housing.

FIGURE 6 is an enlarged view of the portion of figure 5 indicated by the circled labeled "Fig.6".

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FIGURE 7 is a cross sectional view of the valve taken along line 7-7 of figure 1 with the valve shown in a closed and sealed position.

FIGURE 8 is a cross sectional view of the valve similar to figure 7 with the valve shown in a closed but unsealed position.

5 FIGURE 9 is an enlarged view of the portion of figure 9 indicated by the circled labeled "Fig. 9".

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

INVENTION

Referring now to the drawings and initially to figures 1-3, there is illustrated a metering valve 10 that is constructed in accordance with a preferred embodiment of the present invention. The valve 10 is provided with a housing 12 having an dry powder inlet 14 which communicates via an inlet opening 16 to the hollow interior 18 of the valve 10 and through which dry bulk powder material, indicated in figure 3 by arrow **A**, is admitted to the hollow interior 18 of the valve 10.

10 A valve sleeve 20 is provided rotatably suspended within the housing 12 so that the valve sleeve 20 completely covers the inlet opening 16 then the valve sleeve is rotated to the closed position 22 and so that the valve sleeve 20 can be rotated to gradually open the valve 10. Figure 5 illustrates the valve sleeve 20 in the closed position 22 and sealed position. Whenever the valve 10 is open, dry powder material passes through the hollow interior 18 of the valve 10 and exits the valve 10 via an outlet opening 24 provided in the housing 12, as shown in figure 3 by arrow **B**. The valve sleeve 20 is normally rotated via a hydraulic rotary actuator (not illustrated) that bolts onto a distal end 66 of the shaft 40. Alternately, the valve sleeve 20 can be manually rotated by employing a tool that 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 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As shown in figures 3 and 5, the housing 12 of the metering valve 10 is provided with greater clearance or a larger gap 26 between the valve sleeve 20 and the housing 12 on the back side 28 of the valve 10, i.e. the side of the valve 10 opposite the inlet opening 16, and everywhere within the housing except at 5 the sealing surface or lip 63 provided on the front side 44 of the valve 10 adjacent the inlet opening 16. Figure 5 shows in dashed lines the path of rotation of the valve sleeve 20 as the valve sleeve 20 is rotated within the housing 12. Immediately adjacent to the sealing surface or lip 63 in the housing 12, the internal surface 30 of the housing 12 begins to become larger, thus 10 creating a significantly increased clearance or gap 26. This clearance or gap 26 gradually increases to a maximum at the opposite or back side 28 of the valve 10. This increasing gap 26 is achieved by employing a housing 12 that, when viewed in cross section, has an interior surface 30 that is not perfectly circular, but is instead expanded rapidly outward adjacent to the sealing surface or lip 63 15 and continues to expand outward slightly at the back side 28 of the housing 12. This creates greater clearance or a larger gap 26 between the valve sleeve 20 and the interior surface 30 of the housing 12 everywhere except at the sealing surface or lip 63. This greater clearance or larger gap 26 of the valve 10 tends to prevent the dry powder material from being compacted, thereby preventing or 20 greatly slowing down the formation of an unwanted hardened layer in the gap 26. Also, this gap prevents large particles and foreign material from interfering with the housing 12 and valve sleeve 20.

The valve 10 is also provided with an eccentric intermediate sleeve 32 that serves to align the valve sleeve 20 relative to the housing 12. The intermediate sleeve 32 is located eccentric relative to a centerline 10 of the valve 10 and therefore eccentric relative to the interior surface 30 of the housing 12. The 5 intermediate sleeve 32 is attached to a lever 36 for mechanically rotating the intermediate sleeve 32 relative to the housing 12. The intermediate sleeve 32 is provided with a first pair of ball bearing bushings 38 located between the sleeve shaft 40 and the intermediate sleeve 32 and in which the sleeve shaft 40 rotates. The intermediate sleeve 32 is also provided with a second pair of ball bearing 10 bushings 62 located between the intermediate sleeve 32 and the housing 12 in which the intermediate sleeve 32 rotates. Ball bearings are preferably employed in bushings 38 and 62 because the ball bearings allow easier rotation of the sleeve shaft 40 and intermediate sleeve 32. The valve sleeve 20 is attached to one end 42 of the sleeve shaft 40. By rotating the intermediate sleeve 32, this 15 rotational motion of the intermediate sleeve 32 translates into a back-and-forth motion of the valve sleeve 20, thus moving the valve sleeve 20 either nearer to or further from a front side 44 of the valve 10, i.e. the side of the valve 10 through which the dry powdered material enters the valve 10, depending on which way the intermediate sleeve 32 is rotated.

20 The ability to move the valve sleeve 20 toward or away from the front side 44 of the valve 10 independent of the rotational movement of the valve sleeve 20 allows the valve sleeve 20 to move away from the housing 12 at the front side 44

of the valve 10 before the valve sleeve 20 is rotated via the sleeve shaft 40 to open and close the valve 10, and allows the valve sleeve 20 to then move back toward the front side 44 of the valve 10 once the valve sleeve 20 has been rotated. By moving the valve sleeve 20 toward the housing 12 at the front side

5 44 of the valve 10, the valve sleeve 20 thus forms a tighter seal between the valve sleeve 20 and the inlet opening 16 than would otherwise be possible.

Referring now to figures 5 and 6, to further enhance the seal formed between the inlet opening 16 of the housing 12 and the valve sleeve 20, an exterior surface 48 of the valve sleeve 20 is coated with a rubberized layer 50.

10 This rubberized layer 50 seats against a sealing surface in the form of a lip 63 provided on the interior surface 30 of the housing 12 so that the lip 63 encircles that portion of the housing 12 adjacent to and opening into the inlet opening 16.

Figure 7 illustrates the relative position of the valve sleeve 20 to the housing 12, and more specifically the relative position of the rubberized layer 50 of the valve sleeve 20 to the lip 63 provided on the housing 12, when the valve 10 is closed and sealed. Numeral 61 represents the centerline for the eccentric intermediate sleeve 32. In this closed position 22, the rubberized layer 50 is tightly abutted against the lip 63, thereby preventing material from entering the hollow interior 10 of the valve 10.

20 Figure 8 illustrates the relative position of the valve sleeve 20 and the rubberized layer 50 to the lip 63 when the lever 36 is employed to rotate the eccentric intermediate sleeve 32, thereby causing the valve sleeve 20 to move

away from the lip 63 and thus disengaging the rubberized layer 50 from the lip 63. Figures 8 and 9 show the valve 10 in a closed position but unsealed condition, as indicated by numeral 22'. By employing the eccentric intermediate sleeve 32 to move the valve sleeve 20 away from the lip 63 of the housing 12, 5 the layer 50 is disengaged from contact with the housing 12 prior to the valve sleeve 20 being rotated, thereby creating a gap 68 between the lip 63 and the layer 50, as illustrated in Figure 9. The eccentric intermediate sleeve 32 is used prior to opening, closing, or rotating the valve sleeve 20. Without the eccentric intermediate sleeve 32, the layer 50 would be damaged when the valve 10 was 10 opened, closed, or otherwise rotated.

In order to prevent dry powder material from blowing into the mouths 52 of vacuum breakers 54 that are provided on the valve 10, a sleeve shield 56 is provided within the present valve 10. The sleeve shield 56 shields the mouths 52 from the flow of dry powder material passing through the hollow interior 18 of the 15 valve 10. The sleeve shield 56 is secured by means of bolts 58 and a sealing ring 60 to the interior surface 30 of the housing 12 immediately upstream of the mouths 52 of the vacuum breakers 54. As shown in figure 4, the housing is provided with bolt openings 46 for receiving the bolts 58. Sleeve shield 56 extends downstream of the mouths 52 of the vacuum breakers 54 to thereby 20 prevent dry powdered material from being directly blown into the mouths 52 where the dry powder material could become wetted and cause blockage of the mouths 52.

Finally, the bushings **38** and **62** that are provided in association with the intermediate sleeve **32** and that rotatably suspend the sleeve shaft **40** and the attached valve sleeve **20** within the housing **12** utilize ball bearings, thereby making the intermediate sleeve **32** and the valve sleeve **20** easier to rotate.

5 While the invention has been described with a certain degree of particularity, it is manifest that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure. It is understood that the invention is not limited to the embodiments set forth herein for the purposes of exemplification, 10 but is to be limited only by the scope of the attached claim or claims, including the full range of equivalency to which each element thereof is entitled.